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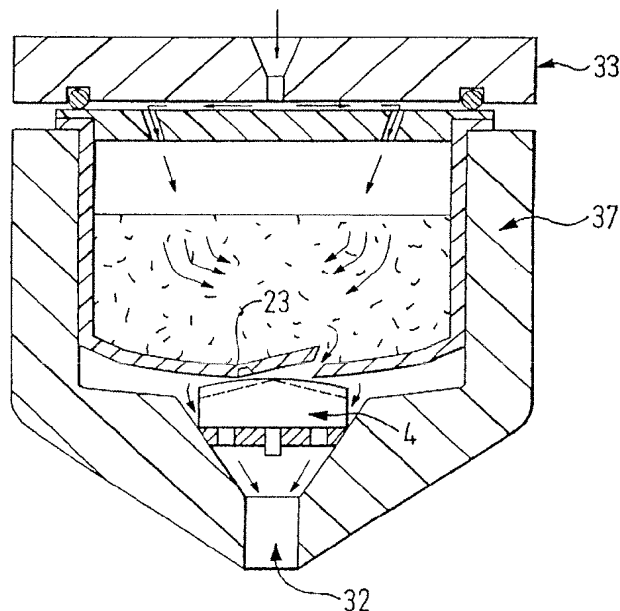
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(54) **Capsule and method for preparation of hot beverage and apparatus adapted for preparing a beverage from such a capsule**

(57) The invention relates to a capsule (10) for the preparation of a beverage obtained by supplying hot water within the capsule under pressure and releasing the beverage from the capsule; said capsule comprising a food substance therein, a first surface (12) adapted to be traversed by a flow of water entering the capsule, a second surface (17) adapted to be traversed by a flow of beverage existing the capsule, wherein the second

surface (17) is adapted to deform outwardly upon action of the inside water pressure thereon and wherein said surface (17) comprises at least one opening member (20) capable of deforming inwards the capsule (10) upon a mechanical reaction force applied from outside onto the opening member (20) as a result of the deformation of said second surface (17) due to the build-up of the inside pressure.



**FIG. 6**

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from the capsule contaminating the beverage at the time the beverage is dispensed through the outlet to the cup.

[0010] In a preferred embodiment, the precut line is arranged so that the opening member forms a valve means that closes upon the build-up of pressure caused by the addition of water inside the capsule till at least a certain pressure level. The valve configuration reinforces the strength of the opening member to the building-up of the inside pressure build-up thereby allowing a sufficient level of pressure to install within the capsule and consequently delaying the release of the beverage. Therefore, it is made possible to control to an appropriate level of pressure inside the capsule which is necessary for reconstituting, such as preferably by dissolution, the beverage before the beverage is released. As preferred embodiments, the precut line may be beveled or, alternatively, be stepped. In a more general manner, the valve means comprises at least one positive edge of the opening member that is capable of holding on a complementarily shaped edge of the opening as a response to the inside pressure thereby causing the closure of the opening member.

[0011] In a preferred embodiment, the foldable portion is of a transversal dimension lower than the peripheral dimension of the precut line. Therefore, the folding of the opening member is facilitated while lowering the risks of rupture or breakage of small bits of capsules.

[0012] Still preferably, the precut line has a width of from 0.05 to 0.3 mm, preferably of from 0.1 to 0.2 mm. Such dimension is suitable for providing a sufficient build-up of the inside pressure while allowing the capsule to deform outwardly until a reaction force can act to release the pressure for providing a high quality and foamy beverage. As defined, the width is also determined with respect to the usual powder size suitable for a proper beverage reconstitution so that no significant amount of powder can inadvertently exit the capsule when the capsule is stored before use.

[0013] In another aspect, the invention relates to a method for preparing a hot beverage using a capsule as previously mentioned comprising the step of providing such capsule, providing hot water entering the first surface and mixing the food substance with the water and build-up a pressure inside the capsule to prepare a beverage; providing means for generating a reaction force from outside of the capsule and opening the second surface by applying said reaction force onto the opening member as a result of the building-up of inside pressure deforming said second surface.

[0014] Preferably, the reaction force generating means and opening member are distant a certain gap before the pressure builds up in the capsule. The gap is determined to take into account the level of pressure desired inside the capsule that translates into a deformation of the capsule; i.e., of the second surface, which closes the gap and effect opening of the capsule. Therefore, the opening member is adapted to interact with the capsule until a certain inside pressure has been created

within the capsule thereby ensuring a controlled building-up of the inside pressure and a delaying of the release of pressure at the required level for improving the dissolution and the quality of foam of the resulting product. In such configuration, the capsule comprises valve means as previously defined so as to resist to the increase of the inside pressure caused by the water entering the capsule.

[0015] More preferably, the opening of the capsule may be effected by build-up of pressure inside the capsule at a level sufficient to cause the second surface to deform outwards and the opening member becomes contacted by the reaction force generating means thereby causing the opening means to resiliently deform inwardly and consequently effecting the release of the beverage. The opening of the capsule may thus be effected automatically in a very precise and reproducible manner as the capsule "inflates" until the opening of the capsule is actuated by the reaction force generating means. Therefore, the reaction force generating means may preferably be distant a certain predetermined gap from the opening member and be positioned in a fixed position with respect to opening member; such predetermined gap corresponding to the required level of pressure deemed necessary for the intended beverage.

[0016] In another aspect the invention relates to an apparatus for preparing a beverage adapted to receive a capsule as defined previously, said apparatus comprising:

(i) a housing arranged for lodging the capsule in a substantially fixed position whereas allowing at least the second surface to deform outwardly upon the action of inside pressure build-up and,

(ii) a reaction force generating means adapted to hold on the opening member and to cause the opening member to move inwardly so as to effect release of the beverage as a result of the pressurization of the capsule with water.

[0017] Preferably, the reaction force generating means comprises a pressure surface adapted to hold on the opening member of the capsule as a response of the increase of inside pressure; said surface being larger than the opening member so as to effect the opening according to a limited range of angulation possible. This allows a release of relatively high pressure suitable for the formation of a nice looking foam. This also allows for a gentler opening of the capsule with lower mechanical stress and consequently reduced risks of contamination by loose bits from the capsule. More preferably, the pressure surface is bulged to limit the size of the opening of the capsule. Such limitation of the size of the opening permits to better control the pressure release for a better foam but also reduces the stress on the opening member.

[0018] The release of the beverage may also be better

opening member forms a valve means which is arranged so that it can withstand a certain inside pressure while substantially closing and, conversely can open inwards as a response to an outside reaction force applied thereon. For that, the precut line 21 is beveled with the outer peripheral edge 24 of the opening member being capable of holding on a complementary edge 25 of the bottom side when a pressure from inside builds up due to water under pressure entering the capsule. Therefore, the precut line is configured so that the section of the opening member gradually decreases outwards. In order to facilitate the inwardly oriented folding of the opening member, a line of weakness 26 may further be provided that promotes bending of the opening member along the privileged line. Such line of weakness may, for instance, be a short outer groove or any suitable equivalent means.

**[0023]** The embodiment of the capsule as shown in Fig. 1 to 3 and 3A is the preferred mode although other variants may provide equivalent results. It has been determined that the precut line should preferably extend along a portion significant enough to be easily bent while limiting the risks of rupturing the plastic material. Preferably, the portion of the precut line should extend along an angular path of from 270 to 350 degrees, preferably 290 to 300 degrees. Similarly, the width of the precut line may be a determining factor that influences the building-up of inside pressure while it also ensures no significant amount of powder can escape from the capsule in the stored conditions. Therefore, it has been determined that the width of the precut line should preferably range from 0.05 to 0.3 mm, preferably from 0.1 to 0.2 mm.

**[0024]** Fig. 3B illustrates a possible variant for the opening member in a configuration wherein it still acts as a valve means having the ability to withstand a certain inside pressure level and conversely, opens under the effect of the outside reaction force. In this configuration, the precut line is shaped to form a stepped configuration with the peripheral edge 24 of the opening member being complementary shaped to be able to hold on the outer edge 25 of the opening of the bottom side as a result of a certain increase of pressure inside the capsule.

**[0025]** Fig. 4A illustrates the capsule of fig. 1 to 3A when lodged in position within a beverage preparation unit 3. The unit comprises a main housing 30 of a size adapted to receive the body of the capsule while the upper edge 13 of the body is retained along a complementary peripheral shoulder 31 of the housing. In the bottom part of the housing 30 is provided a beverage outlet 32 for the release of the beverage toward a dispensing area (not shown).

**[0026]** According to an important aspect of the invention, the beverage preparation unit comprises a means 4 for providing a mechanical reaction force to the opening member 20 of the capsule as a response to the deformation of the capsule; i.e., the outward or downward expansion of the second surface, due to the building-up

of inside pressure during the water filling of the capsule. For that, the reaction force generating means 4 consists of a plunger 40 vertically aligned with the opening member 20 and the outlet 32. The plunger 40 is fixed in position on an apertured support 47 that leaves the outlet substantially open. More precisely, the plunger 40 includes a pressure surface 41 adapted to hold on the opening member 20. The pressure surface is arranged so that it has a surface larger than the surface of the opening member. The pressure surface also has a non-aggressive shape not to cause puncturing or piercing of the capsule but, on the contrary, to effect opening of the opening member 20 by gently moving the member inwards along an opening path of limited angulation along the folding portion of the member. For that, it is preferred to have a pressure surface that is bulged.

**[0027]** FIG. 4 illustrates a first embodiment of the plunger wherein the pressure surface is a single bulged portion of radius R. Suitable bulge radius R may preferably be of from about 40 to 80 mm. In order to release the pressure in a controlled manner, channels 42 are provided at the surface of the plunger which extend from the area intended to be covered by the opening when the plunger contacts the opening member. The channels preferably extend radially so as to distribute uniformly the foam and then, the liquid within the outlet. The channels are important since they determine the flow velocity and produces turbulences that creates the foam. Other configurations of channels could also possibly be proposed such as several channels which traverse through the plunger. Fig. 4B illustrates a second possible embodiment wherein the pressure surface is composed of a first main bulged portion of radius  $R_1$  intersected in the center by a second smaller circular portion of radius  $R_2$ ; with  $R_2$  being smaller than  $R_1$ . As a preferred example,  $R_1$  ranges from 40 to 80 mm and  $R_2$  ranges from 20 to 40 mm.

**[0028]** As shown in Fig. 4 and 7, when in at rest position; i.e., before the water pressurization, the housing of the unit is dimensioned so that the capsule, more specifically the opening member 20 of the capsule, is kept distant the pressure surface 41 a certain gap "d" necessary to generate a desired increase of pressure inside the capsule as the valve means of the opening member is sufficient to withstand that amount of pressure.

**[0029]** The preparation cycle is demonstrated in accordance with Fig. 4 to 8. In a first stage, the capsule is positioned in the housing of a first unit part 37 and locked in position by means of an upper part 33 of the unit. The upper unit part 33 comprises a water distribution chamber 34, a water inlet 36 and a watertightness means 35 adapted to render the chamber watertight upon closing. The lower unit part 37 and the upper unit part 33 engage together in closure by any suitable driving means such as an hydraulically driven assembly (not shown). In a closed configuration of the housing, the plunger 40 is positioned at a distance from the capsule and there is a small predetermined gap "d" between the capsule open-

- member comprises a continuous precut line cutting through the thickness of the second surface and wherein the opening member comprises a resilient folding means which is adapted to cause the opening member to fold upon action of said reaction force applied from outside onto the closure means to effect release of the beverage.
3. Capsule according to claim 2, wherein the resilient folding means comprises a single foldable portion arranged with respect to said precut line so that the opening member is capable of moving inwardly by folding along said foldable portion.
  4. Capsule according to claim 2 or 3, wherein the precut line is arranged so that the opening member forms a valve means that is capable of closing upon the build-up of pressure caused by the addition of water inside the capsule till at least a certain pressure level.
  5. Capsule according to claim 4, wherein the precut line forms a valve means with a positive edge of the opening member holding on a complementarily shaped edge of the opening upon the build-up of pressure inside the capsule.
  6. Capsule according to claim 5, wherein the precut line is beveled.
  7. Capsule according to claim 5, wherein the precut line is stepped.
  8. Capsule according to claim 2 or 3, wherein the foldable portion is of a transversal dimension lower than the peripheral dimension of the precut line.
  9. Capsule according to claim 8, wherein the foldable portion further comprises a line of weakness promoting bending of the opening member along a privileged line.
  10. Capsule according to any of claims 2 to 9, wherein the precut line has a width of from 0.05 to 0.3 mm, preferably of from 0.1 to 0.2 mm.
  11. Capsule according to any of claims 2 to 10, wherein the opening member is demarcated by the precut line so as to substantially form a portion of circle.
  12. Capsule according to any of claims 2 to 11, wherein the portion of circle is of from 270 to 350 degrees.
  13. Capsule according to claim 12, wherein the portion of circle has a diameter of from 3 to 15 mm.
  14. Capsule according to any of the preceding claims, wherein the food substance is a soluble food product.
  15. Capsule according to any of the preceding claims, wherein the soluble food product is selected among the group consisting of coffee, tea, cocoa, milk, and combinations thereof.
  16. Method for preparing a foamy hot beverage comprising :
    - providing a capsule comprising a food substance therein, a first surface adapted to be traversed by a flow of water entering the capsule, a second surface adapted to be traversed by a flow of beverage exiting the capsule, wherein said surface comprises at least one opening member capable of creating an opening upon actuation from a mechanical reaction force applied from outside onto the opening member to effect release of the beverage;
    - providing hot water entering the first surface and mixing the food substance with the water and build-up a pressure inside the capsule to prepare a beverage;
    - providing means for generating a reaction force from outside of the capsule and,
    - opening the second surface by applying said mechanical reaction force onto the opening member as a result of the build-up of inside pressure deforming said second surface.
  17. Method according to claim 16, wherein the opening member and the reaction force generating means are kept distant a certain predetermined gap before the required pressure builds up in the capsule
  18. Method according to claim 17, wherein said gap is of from 0 to 5 mm, preferably 0.1 to 3 mm.
  19. Method according to claim 17 or 18, wherein opening of the opening member is effected by build-up pressure inside the capsule sufficiently to cause the second surface to deform outwards and to be held on the reaction force generating means thereby causing the opening means to deform the opening means inwardly and to consequently effect release of pressure and dispense of the beverage.
  20. Method according to any of claims 16 to 19, wherein the reaction force generating means is fixed in position with respect to the opening member.
  21. Method according to any of claims 17 to 20, wherein the reaction force generating means comprises a pressure surface adapted to hold on the opening

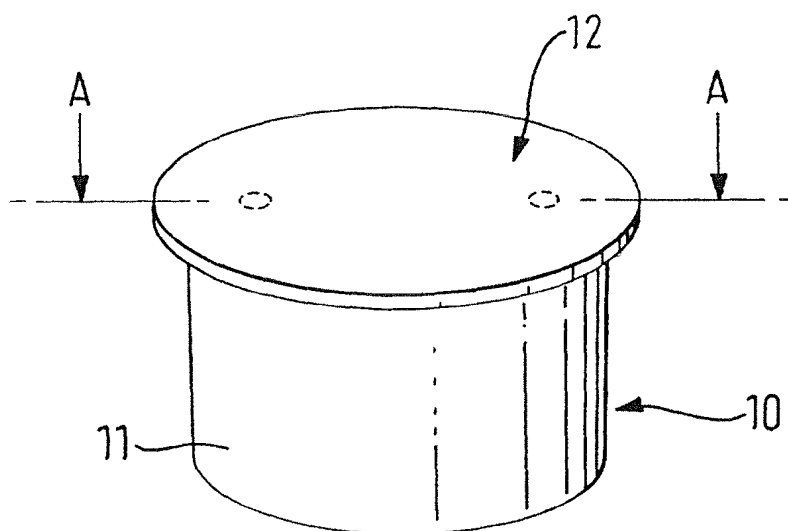


FIG. 1

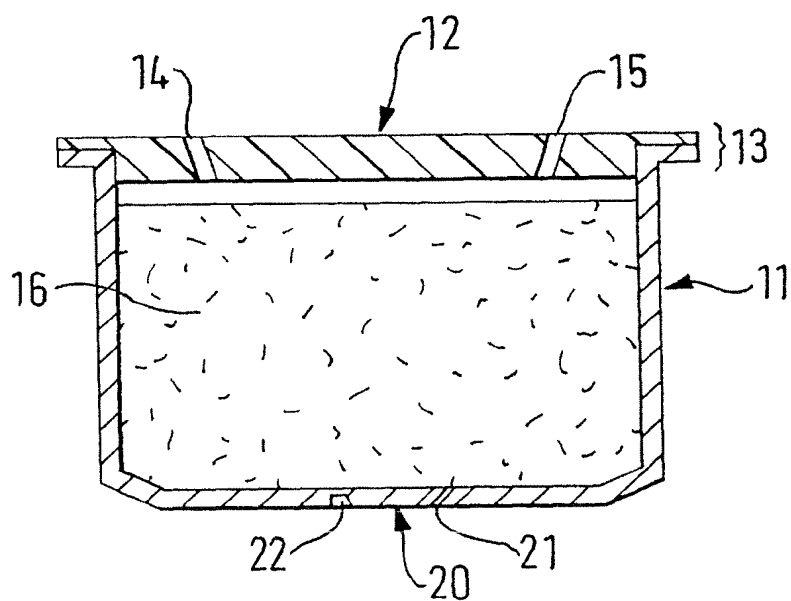


FIG. 2

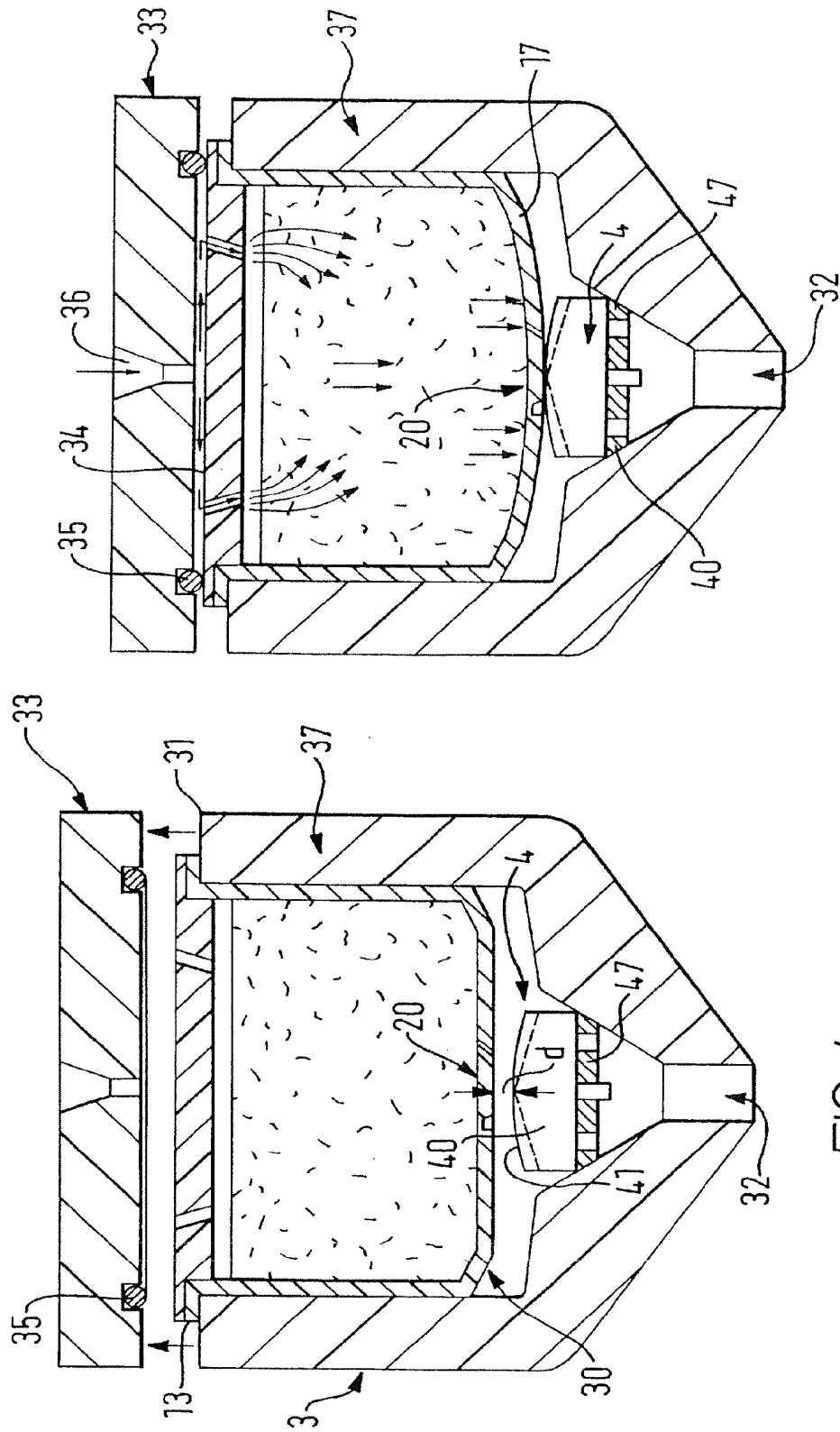
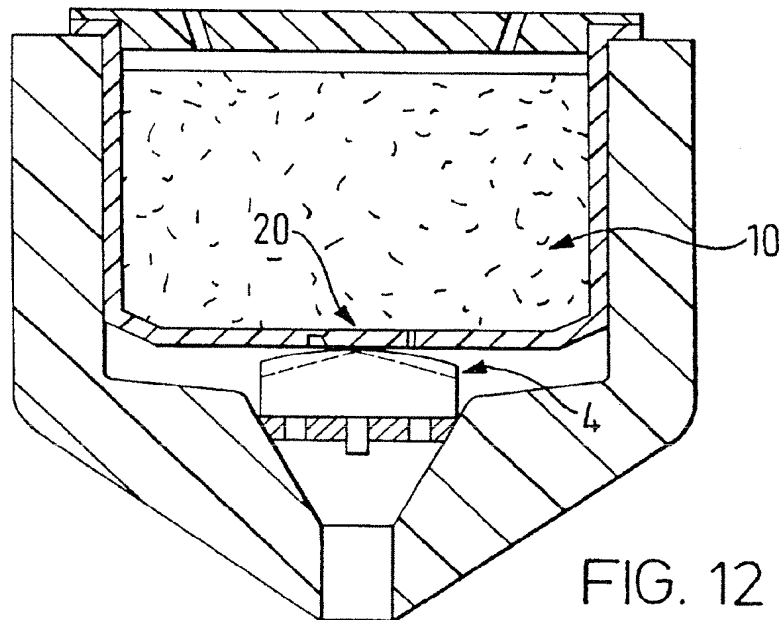
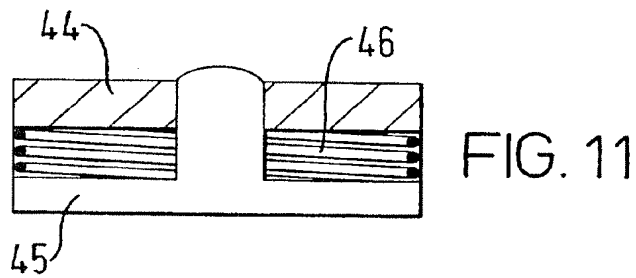
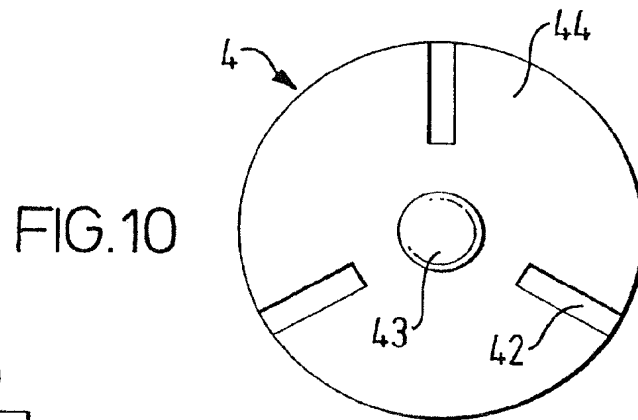
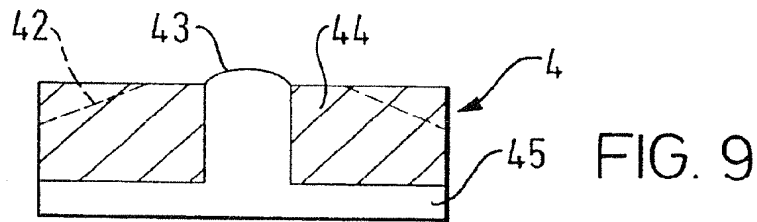


FIG. 4

FIG. 5



**ANNEX TO THE EUROPEAN SEARCH REPORT  
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EP 01 10 7306

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